# DO THE ABIETINEAE EXTEND TO THE CARBONIFEROUS?

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(WITH PLATE XXVI AND TWO FIGURES)

JEFFREY and CHRYSLER, in a recent monograph on the Pityoxyla of the Cretaceous (**4**), assign much importance to the presence of *Pityoxylon Chasense* in the Permian and to the supposed occurrence of *P. Conwentzianum* in the Carboniferous, as indicating the great geological age of the Abietineae. They state (p. 13):

> The *Pityoxylon Conwentzianum* of GOEPPERT from the Carboniferous of Waldenburg, which has often been called in question, has received full confirmation from the description of a similar type of *Pityoxylon, P. Chasense,* by PENHALLOW, from the Permian of Kansas. In these two species vertical resin canals are said to be absent, although the horizontal canals of the fusiform rays are clearly present. There is, accordingly, every reason to believe that the Abietineae are a very ancient group in their first appearance. In fact, they may be traced geologically quite as far back as the Araucarineae, which it is customary at the present time to regard as the oldest of the Coniferales.

More recently GOTHAN (**2**) has again "called in question" the authenticity of *P. Conwentzianum* as a Carboniferous form. He shows that this species whose horizon was never determined cannot, on structural grounds, belong to the Carboniferous. In this regard he refers (1) to the modern character of the radial pitting of the tracheids, which he has shown (**1**) is entirely lacking in all true Carboniferous woods; and (2) to the typical annual rings which are present, which are not found in any Carboniferous form. He also refers to the doubt expressed by Count SOLMS as to the validity of *P. Conwentzianum,* and to the fact that no more material of it can be found in the Carboniferous of Waldenburg, from which much wood is known. Finally, he again emphasizes the uncertainty as to the source and horizon of the material, which he states was found "auf eine Halde (!) des Waldenburgischen" (**2,** p. 22). No reliance can thus be placed on this form as indicating the presence of the Abietineae in the Carboniferous.

*P. Chasense* was described by the late Professor D. P. PENHALLOW in 1900 from material which was collected by C. S. PROSSER

from the "Chase Formation (Permian) at Coon Creek, Chase Co., Kansas, in 1897" (PENHALLOW **5**, p. 76). The type set of sections is the property of the Peter Redpath Museum, and through the courtesy of the McGill authorities has been put at our disposal for study. It is to be regretted, however, that no more material of the specimen from which the sections were prepared can be found. Careful search has been made both at McGill and at Washington (U.S. Geological Survey), where PROSSER sent his collection. The sections are three in number, transverse, radial, and tangential. They are labeled "*Pityoxylon Chasense*, 5, Cretaceous,[1] C. S. Prosser." Plate figs. 1–3 show these at a low magnification. The matrix is siliceous, but the material is only "fairly well preserved," and though the sections have been excellently made, certain important structural features are not determinable. PENHALLOW'S description is very brief, and is not illustrated. This renders it difficult to correlate it with the sections.

The transverse section is 12.5 mm. in radial extent, and in that distance shows no growth rings, so that it seems probable that these are absent or at least poorly developed, as PENHALLOW has stated. This feature and the form and arrangement of the tracheids are shown in plate fig. 4. The absence of annual rings is not a characteristic of the genus *Pityoxylon* of KRAUS, and yet in spite of this, and in spite of other important features which indicate its cordaitean affinity, PENHALLOW placed this form under that genus, because of the occurrence of what he considered were horizontal resin canals.

Text fig. 1*A* illustrates the character of the medullary ray cells in radial section. They are four to five times as long as high, and, as compared with the tracheids, are thin-walled; the radial extent of the latter and the thickness of their walls are indicated by the sets of short lines below the parenchyma cells. Many rays were examined, but no pits could be found on either the horizontal or terminal walls, nor is there any special thickening of these walls, features which are characteristic of *Pityoxylon*. Their structure, on the contrary, is of the characteristic cordaitean or *Araucarioxylon* type.

[1] There would seem to have been an error in labeling these "Cretaceous," since the Chase formation is Permian, as PENHALLOW himself has stated in his description.

The radial pitting of the tracheids is illustrated in text fig. 1*B*, which is taken from the radial section at the place marked *d* in plate fig. 2. The bordered pits are "in 1–3 rows, chiefly 2 rows."[2] They are alternate in arrangement, and flattened, as it were, by mutual contact, often presenting a more or less hexagonal outline. The orifice is not "probably round," however, though such appearances are quite common where the preservation is defective (text fig. 1*C*).

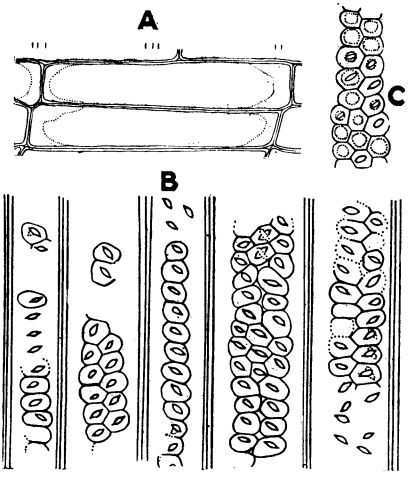


FIG. 1

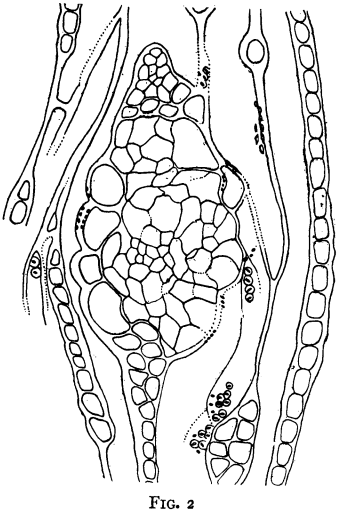

FIG. 2

FIGS. 1–2.—Fig. 1, from radial cross-section: *A*, medullary ray cells; *B*, radial pitting of tracheids (from plate fig. 2 at *d*); *C*, radial pitting in poor state of preservation; ×250; fig. 2, from tangential section (plate fig. 3 at *a*): showing tissue continuous and also tangential pitting adjacent to the ray; ×100.

Even here transitions to the normal type can be observed. It is elongated and obliquely placed, the two orifices on contiguous walls in some cases showing at right angles to one another (first and second tracheids from the right in text fig. 1*B*). This is not the character of the radial pitting of *Pityoxylon* as defined by KRAUS (SCHIMPER and SCHENCK **6,** p. 852), "Aréoles unisériées; opposées lorsqu'il y en a deux rangs," but that of an *Araucarioxylon* or cordaitean form.

The presence of horizontal resin canals upon which "*P. Chasense*" is referred to the genus *Pityoxylon* is exhibited, according

[2] Fifty counts were made in different parts of the radial section with the following result: 1-seriate 16 per cent, 2-seriate 62 per cent, and 3-seriate 22 per cent.

to PENHALLOW, "in the tangential section only, probably in consequence of the special condition of preservation," though what that "special condition" may be when the sections are all made from the same block is not evident. This feature, however, is considered important enough, in spite of the above described cordaitean features, to "separate the plant from *Cordaites*, and its affinities are rather with the *Pityoxylon* of KRAUS."

In the tangential section there are four broad medullary rays (plate fig. 3, *a*, *b*, *c*, *d*) with their tissues in a fair state of preservation, the two best preserved of which are shown in figs. 6 and 7. There are also traces of two more. PENHALLOW'S description of these is "fusiform rays, the terminals linear and of the structure of the uniseriate rays; the central tract very broad, nearly round; the cells large, thin-walled, irregular, and enclosing a small central resin passage with large epithelium cells." The writers have examined all these rays carefully, and the sketch (text fig. 2) was made after a prolonged study of the best preserved one (fig. 6). The camera lucida was used to outline this, but a few details were added afterward. It shows the tissue continuous from side to side of the ray, neither could there be found in this nor in any of the others a trace of a "small, central resin passage with large epithelium cells." Fig. 7 shows the only one that could be considered to have anything resembling a resin canal in it, and it was found by the use of the polariscope that the two darker areas (*a* and *b*) in this were due to aggregates of crystals of silica. Partial outlines of the crystals appear in the photograph.

Since the writers could find no evidence of resin canals in these large fusiform rays, it became interesting to know their real character. A significant feature in this connection is the irregularity of their margin, which is very different from that found in rays in the pines with horizontal resin canals, or even in such abnormal cases as those of *Sequoia Penhallowii* (JEFFREY 3). Around the rays, moreover, there is a considerable amount of tangential pitting on the tracheids (text fig. 2), a feature which is not found in any form known to the writers in connection with rays which inclose resin canals. This, however, is a feature of medullary rays which contain leaf traces, and since we have found undoubted leaf

traces in the radial and transverse sections of *P. Chasense* in rays which are quite similar in size and structure to those in the tangential section (cf. plate figs. 6 and 7 with fig. 8), it is considered that these are identical with the fusiform rays described by PENHALLOW. In the radial section they pursue an almost horizontal course (plate figs. *2a* [?] and *b*), as is the case in the old wood of the Araucarineae. Further explanation need not be entered into here, since one of the writers is preparing a contribution to the character of the leaf trace in certain fossil and living conifers, in which this feature will be studied in detail.

Since, then, the so-called resin canals of "*Pityoxylon Chasense*" are proven not to be such, there is left no basis for calling this form a *Pityoxylon*. On the other hand, (1) the absence of annual rings, (2) the character of the ordinary medullary rays (1 to partly 2-seriate with cells of thin-walled unpitted parenchyma), and (3) the multiseriate, alternate, and hexagonal radial pitting of the tracheids afford clear indication of its cordaitean affinity. This form, then, instead of affording "full confirmation" (*op. cit.*, p. 1) of the authenticity of *P. Conwentzianum*, lends no support to it, but might rather be considered as emphasizing the insecurity of the evidence upon which, as GOTHAN has recently shown (see p. 1), the latter is referred to the Carboniferous. The claim for the great geological age of the Abietineae thus fails on critical study of both the Permian and the Carboniferous forms upon which it is based.

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## DESCRIPTION OF PLATE XXVI

FIG. 1.—Transverse section in two parts (*a* and *b*); ×5.

FIG. 2.—Radial section: at *a*, a possible branch; at *b*, a leaf trace cut longitudinally; at *c*, one cut obliquely; and at *d*, the pitting shown in text fig. 1*C*; ×5.

FIG. 3.—Tangential section: *a*, *b*, *c*, *d* are the fusiform rays; ×5.

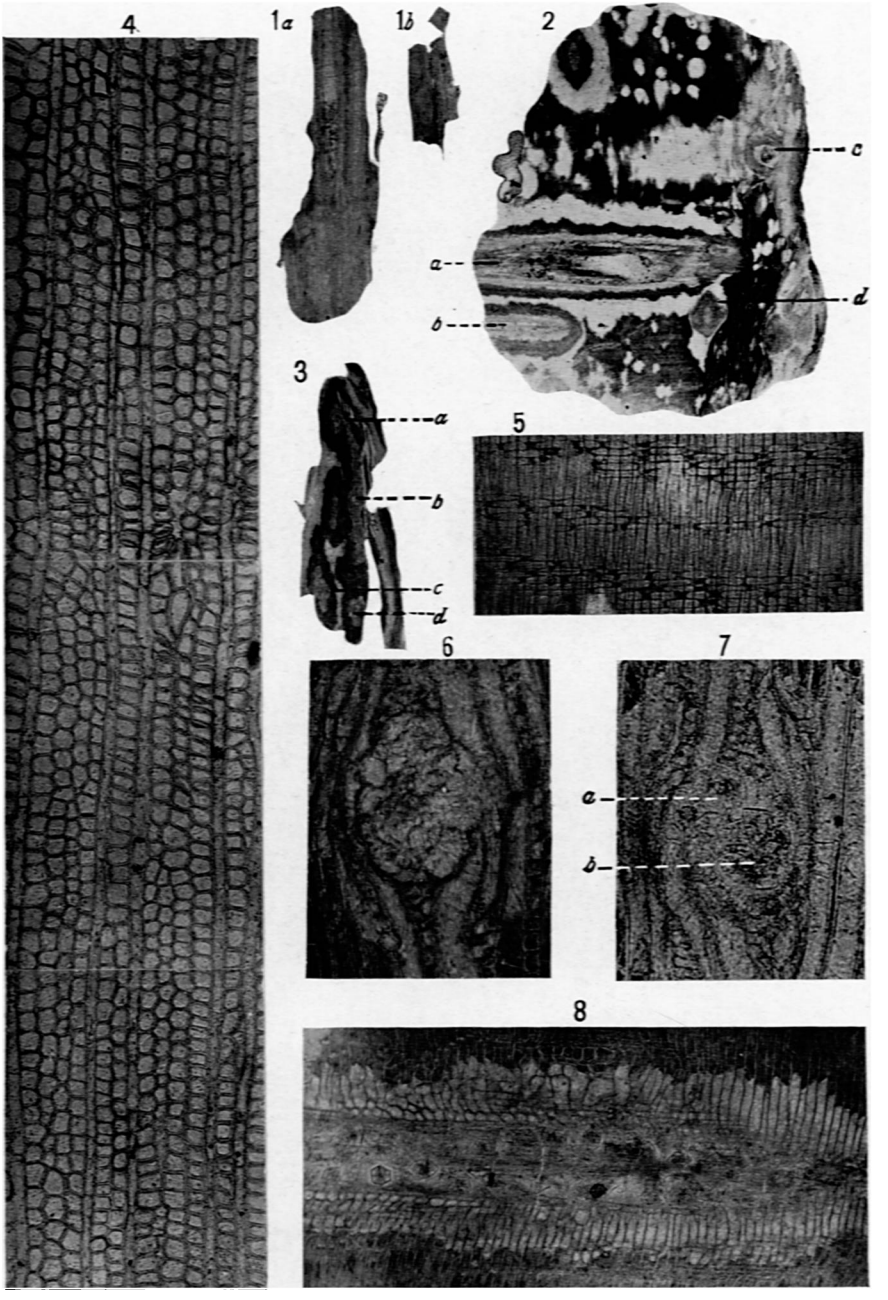
FIG. 4.—Transverse section: showing tracheids and medullary rays with no annual rings; the figure is from three photographs combined; ×80.

FIG. 5.—Radial section of medullary rays; ×40.

FIG. 6.—Tangential section of best preserved medullary ray (*a* in fig. 3) from which text fig. 2 was drawn; ×80.

FIG. 7.—Tangential section of a medullary ray (*d* in fig. 3) with two aggregates of crystals of silica in it at *a* and *b*; ×80.

FIG. 8.—Radial section of the leaf trace, from fig. 2*b*; ×40.




THOMSON & ALLIN on PITYOXYLON